

Architectures and assessment of next-generation CMB polarization instruments

Completed Technology Project (2014 - 2015)



Project Introduction

Cosmological inflation predicts a background of gravitational waves that imprint a characteristic polarized pattern on the CMB. This signal is degraded by "foreground" emission from our galaxy, and by non-ideal aspects of the instrument. Future missions must be motivated by end-to-end pipelines that include systematics and sophisticated representations of astrophysical foregrounds and cleaning. We plan to write a pipeline that will quickly close the loop between design choices and projected scientific outcomes.

The curl-like component of the polarization field, or "B-mode" is the primary target of the next generation of cosmic microwave background polarization experiments. B-modes can be sourced by gravitational waves produced during cosmological inflation, subsequent gravitational lensing of CMB polarization, or by astrophysical "foreground" polarized emission. The inflationary component of the B-modes is of greatest scientific interest because it would reflect energy scales and physics significantly beyond the reach of terrestrial accelerators. To secure a clear statement on inflation as the correct interpretation, the other sources of B-modes must be cleanly removed or ruled out. The new experimental burden is now not on detecting B-modes but showing convincingly that they are inflationary.

Basic decisions about focal plane arrangements, optical design, frequency bands, sensitivity, and survey strategy all interact and drive mission costs. There is not a simple analytic expression relating design parameters to scientific output. Instead, these questions must be addressed using an end-to-end simulation that can quickly close the loop and evaluate design decisions.

Anticipated Benefits

Next-generation missions must be motivated by end-to-end pipelines that include systematics and sophisticated representations of astrophysical foregrounds and cleaning.



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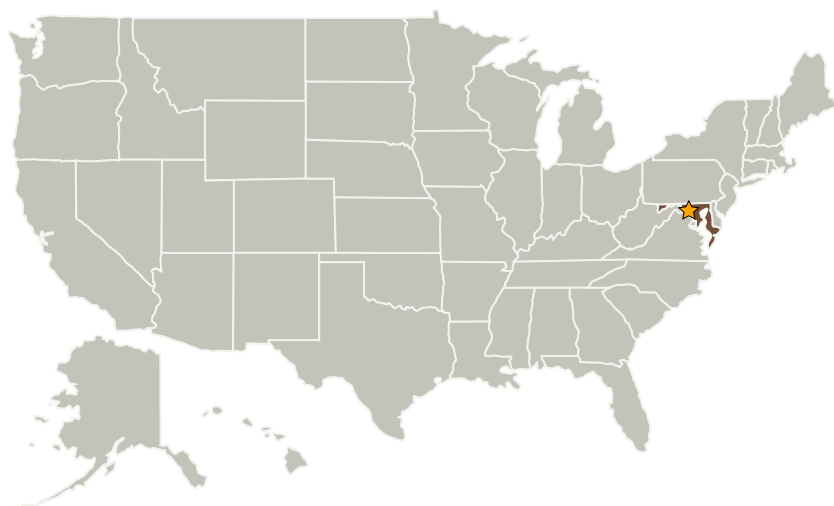
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations

Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Manager:

Stanley D Hunter

Principal Investigator:

Eric R Switzer

Co-Investigators:

Alan J Kogut

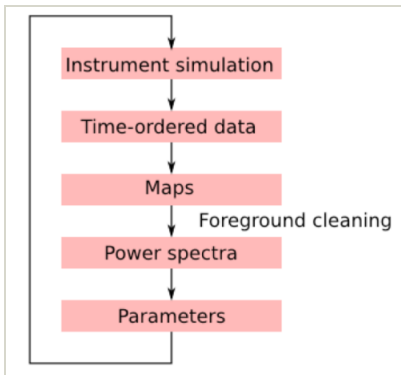
David T Chuss

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Images



CMB polarization analysis pipeline

A full end-to-end pipeline to assess instrumental systematics and foreground subtraction.

(<https://techport.nasa.gov/image/4199>)

Links

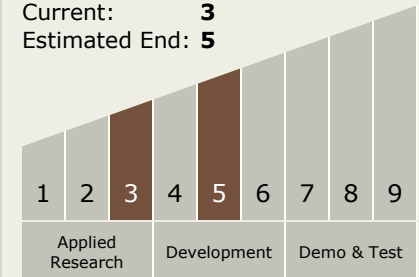
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Project Website:

<http://sciences.gsfc.nasa.gov/sed/>

Technology Maturity (TRL)

Start: **3**
Current: **3**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - TX08.1 Remote Sensing Instruments/Sensors
 - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves